



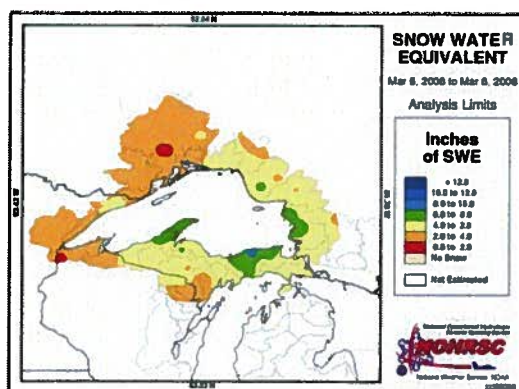
**US Army Corps  
of Engineers  
Detroit District**



# Great Lakes Update

## 2008 Annual Summary

Lakes Superior remains in its longest period of continuous below average water levels since 1918. Lake Michigan-Huron continued its second longest period of continuous below average water levels since 1918. Both lakes however are above their 2007 water levels when they set or came close to setting new record lows. An active storm track during the winter of 2008 brought much above average snow to the northern Great Lakes. Although some of the snow was of the lake effect variety, much of it came from weather systems originating outside of the basin. Figure 1 shows above average snow water equivalent (SWE) across the Lake Superior basin due to the active weather pattern.



**Figure 1: 2008 Snow Water Equivalent**

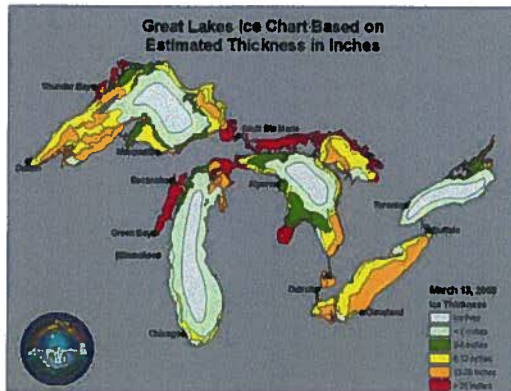
The National Weather Service conducts snow surveys using low flying aircraft over the Great Lakes each year to help with predictions of water supplies to the Great Lakes. Above average SWE in 2008 lead to significant seasonal rises on Lake Superior and Lake Michigan-Huron. Lake Superior rose 18 inches versus an average rise 12 of inches. Lake Michigan-Huron rose for 7

consecutive months starting in January. Its rise was 21 inches versus an 11 inch average rise.

Lakes St. Clair, Erie and Ontario rose sharply to start 2008. Lake St. Clair, bolstered by very wet weather in 2008, rose to near average water levels by February. The lake remained near average through April and then was a few inches below its long term average (LTA) from May through December. Lake Erie rose steadily from November 2007 through April 2008. Lake Erie's water level was above its LTA from February to May and near its LTA for the rest of 2008. Lake Ontario followed a similar pattern and rose quickly beginning in January. By May, the lake was 11 inches above its LTA. The sharp rise on Lake Ontario was a result of very wet conditions in the basin and a regulation strategy to account for much above average snow melt across the Ottawa River basin. Lake Ontario remained above its LTA through October.

### Hydrology

Figure 2 shows the maximum extent of ice cover during 2008 occurring in mid-March. Ice cover prevents loss of water due to evaporation. In an average year, the largest evaporation rates occur in late fall and early winter when air temperatures are often much colder than the water surface temperatures. Once solid ice cover forms, evaporation stops. In 2008, evaporation rates were very typical to an average year. Evaporation rates during the winter months in 2008 were much less than the same period in 2007. Figure 3 shows the current ice cover on the Great Lakes.



**Figure 2: 2008 Maximum Ice Cover**



**Figure 3: Current Ice Cover**

### **Forecast**

The latest water level forecast predicts higher water levels on Lake Superior and Lake Michigan-Huron when compared with 2008. The remaining lakes are expected to have lower water levels than 2008. Lakes Superior, Michigan-Huron and St. Clair are forecasted to remain below their LTA through mid 2009. Lake Erie is forecasted to remain near its LTA, while Lake Ontario will hover above its LTA in early 2009 and return to near average by March.

Seasonal outlooks issued by the National Weather Service's Climate Prediction Center show an increased chance for above average temperatures in early 2009. These outlooks also call for equal chances of above, below and normal precipitation. If the current active storm track continues into the New Year, water levels of the Great Lakes may trend toward the upper

band of the forecast.

### **Water Levels**

The "Monthly Bulletin of Lake Levels for the Great Lakes" displays water levels for the years 2007 and 2008. The following discussion is based on monthly mean levels.

Lake Superior levels began 2008 at 600.7 feet, about 10 inches below its January long-term average (LTA). Levels peaked in August at 601.8 feet, about 5 inches below its August LTA. Lake Superior normally peaks in August or September. Lake Superior's level ended the year at 601.0 feet; 8 inches below its December LTA.

Lakes Michigan-Huron began the year at 576.4 feet, about 25 inches below its January LTA. The lakes peaked at their normal time in July at 578.2 feet, about 14 inches below the July LTA. The year ended with a level of 577.3 feet; 16 inches below the December LTA.

Lake St. Clair levels started the year at 573.0 feet, about 7 inches above its January LTA. Levels peaked at its normal time in July, at 574.5 feet, about 4 inches below the July LTA. St. Clair's level ended the year at 573.5 feet; 5 inches below the December LTA.

Lake Erie began 2008 at 570.7 feet, about 1 inch below its January LTA. Levels peaked in April, two months earlier than usual, at 572.2 feet, about 7 inches above its April LTA. The year ended with a near average level of 570.8 feet.

Lake Ontario began the year at 244.6 feet, at its January LTA. Levels peaked in May, a month earlier than usual, at 247.0 feet, about 11 inches above the May LTA. The year ended with a level of 244.9 feet; 5 inches above December's LTA.

### **Lake Superior Regulation**

During 2008 Lake Superior water levels remained below average but were higher than those of 2007. Outflows continued to be set by the International Lake Superior Board of Control (Board) using Regulation Plan 1977-A. The Board is a bi-national body that reports to the International Joint Commission (IJC) on boundary water management issues including the management of Lake Superior outflows. Flow changes resulting from monthly Lake Superior regulation are accomplished by varying the amount of water allocated to hydropower production and, when necessary, opening or closing gates in the Compensating Works at the head of the St. Marys Rapids.

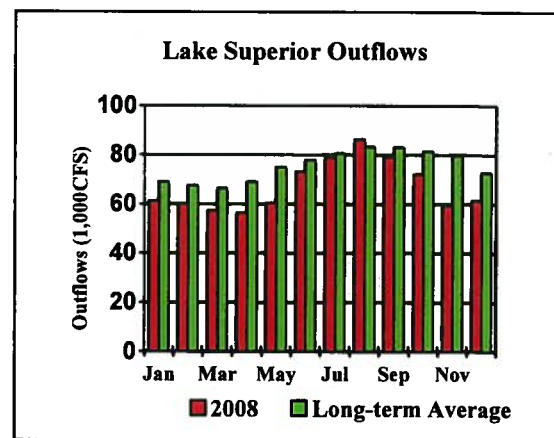
Water supplies to Lake Superior were slightly below average for 2008. January, April, June, July and December supplies were above average. Annual precipitation over the Lake Superior basin was near average during 2008. April, May, June, July and September were above average with the April through July period providing 14.87 inches, 3.59 inches above the usual amount for this period. Total 2008 Lake Superior basin precipitation was 30.32 inches, 0.20 inches below the usual annual amount.

Except for August, a one-half gate open setting was maintained during 2008 in the Compensating Works. This was to maintain minimum flow requirements in the St. Marys Rapids and to support spawning in the fishery. The August outflow of 86.2 thousand cubic feet per second (tcfs) required a one-gate open setting at the Compensating Works.

Flow variations due to peaking and ponding operations by the hydropower plants at Sault Ste. Marie, Michigan and Ontario cause St. Marys River water levels downstream from the plants to fluctuate. When Lake Superior levels and outflows are below average, these fluctuations can be of concern to commercial navigation. When water levels at the U.S. Slip Gauge fall below 577.7 feet (IGLD 1985) ponding by the hydropower entities is suspended on weekends

and holidays with an 8-hour window of peak flow required for each weekend and holiday. Ponding was suspended on weekends and holidays by the Board for the first two weekends in January and again starting on March 25, 2007 through April.

Outflows were 89% of average in 2008, ranging from a low of 56.2 tcfs in April to a high of 86.2 tcfs in August. Figure 4 below compares the monthly Lake Superior outflows in 2008 to long-term average flows for the 1900-1999 period of record.



**Figure 4: Lake Superior Outflows**

### **Lake Ontario Regulation**

Increasing concern about continued low supplies and levels throughout the Lake Ontario-St. Lawrence River system as well as low levels in the upper Great Lakes and record low Montreal Harbour levels resulted in a December 12, 2007 decision by the International St. Lawrence River Board of Control (ISLRBC) to continue restoring water that had been removed from Lake Ontario as the result of earlier over-discharges totaling 4.7 inches. These over-discharges, which were made to increase levels on Lakes St. Lawrence and St. Louis had accumulated during the fall and were in addition to previous winter and spring over-discharges to alleviate high water levels on Lake Ontario. Short term increased outflows were authorized when required to maintain Point-Clair levels at 67.6 feet until the end of the navigation season. Any opportunity

to restore water to Lake Ontario was taken advantage of. Short term outflow deviations were authorized to meet critical needs of other interests, including hydropower. The Board reaffirmed that it would ensure that regulation activities remained balanced in the best interests of all stakeholders.

While Lake Erie's below average level resulted in below average outflows to Lake Ontario, the December precipitation over the Lake Ontario basin was well above average resulting in a total supply 102% of average causing the lake to rise 6.3 inches. Its usual December rise is 0.4 inches.

By January 8, 2008 the Lake Ontario level was 244.36 feet, 2.8 inches below average, 18 inches below 2007 and about 2.4 inches lower than it would have been had Plan 1958-D been strictly applied over the course of 2007. Below average levels were forecast for the first few months in 2008.

After reviewing Lake Ontario-St. Lawrence conditions, the ISLRBC in a January 9, 2008 teleconference decided to continue restoring water to Lake Ontario. 2.4 inches of water had been restored over the past month, primarily when Montreal area ice conditions forced an outflow reduction to avoid damage to Hydro Quebec facilities.

Lake St. Louis levels were below record monthly minimums for several days in December and January. The level remained well below average until early January and then rose to near average. Once navigation on the Seaway closed, the Board's strategy was to assure Lake St. Louis levels remained above 67.6 feet, the low level constraint for drinking water intake purposes.

Ice cover began to form in the international section of the river upstream of the Moses Saunders Dam on January 25<sup>th</sup> and to reform in the Beauharnois Canal from January 29<sup>th</sup> to February 8<sup>th</sup>. The Iroquois Dam gates were dipped slightly from February 15<sup>th</sup> through March 19<sup>th</sup> to aid formation of a stable ice cover. Except for eight days between mid December to

and the end of February, the Board prescribed less than Plan 1958-D flows each day in order to assist formation of a stable, secure ice cover. By February 25<sup>th</sup> most of the accumulated over-discharge was effectively eliminated, leaving only 0.4 inches of water to be restored to Lake Ontario. Near record precipitation in February resulted in well above average Lake Ontario net basin supplies. The higher supplies and reduced flows needed for ice management resulted in a sharp rise in levels. A lack of very cold weather hindered formation of a solid ice cover and it began slowly dissipating in early March.

Lake Ontario's beginning of March level was 245.37 feet, 6.7 inches above the LTA. Above average snow-pack on the basin resulted in higher than average snowmelt over the region raising the Lake Ontario level to 245.63 feet, 7.9 inches above average. Ice remained on Lake St. Francis and in the Beauharnois Canal.

The Board met March 18-19 and reviewed Lake Ontario-St. Lawrence system conditions. It decided to set outflows as prescribed by Plan 1958-D. Over the winter nearly all of the remaining over-discharges for 2007 were restored primarily due to reduced outflows necessary for ice management. Only 0.3 inches of water remained to be restored to Lake Ontario. Short term increased outflows continued to be authorized to maintain Point-Clair levels above 67.6 feet for navigation requirements, to avoid flooding in the Montreal area and meet other interest needs, including hydropower.

Ice booms were installed by the hydropower entities in the international section of the River to aid in the formation and stabilization of ice cover. These booms were removed by April 8 without incident after the ice had dissipated.

Outflows from the Ottawa River were well above average during March and April and reached record high values for the second half of April due to runoff from the well-above average snow pack. Toward the end of April the Ottawa freshet resulted in high Ottawa River flows, which combined with the Lake Ontario outflow



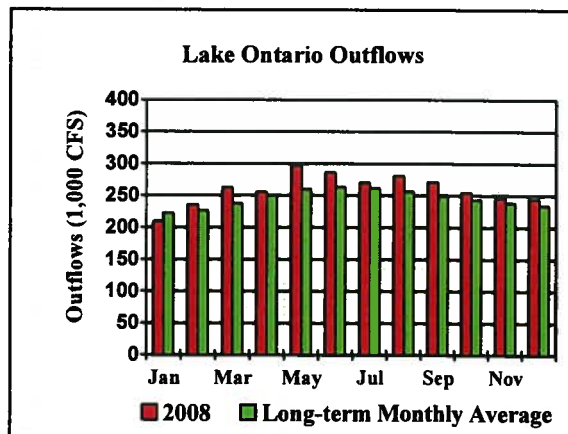
caused Lake St. Louis to rise above flood alert level. To prevent serious flooding in the Montreal area the Board reduced Lake Ontario outflows. From April 10<sup>th</sup> to May 6<sup>th</sup> Lake St. Louis levels exceeded the flood alert level of 72.5 feet but remained below flood stage level of 73.3 feet due to under-discharge deviations. This resulted in some water being stored on Lake Ontario. By April 14<sup>th</sup> Lake Ontario's level was 246.6 feet, 11.8 inches above average. By May 1<sup>st</sup> Lake Ontario's level was 2.5 inches higher than the level called for by Plan 1958-D.

On May 1<sup>st</sup> the Board decided to increase Lake Ontario's outflow. The Ottawa River freshet had peaked and Ottawa River flows were receding. Lake Ontario's level rose by 14.2 inches in April compared to its average rise of 8.3 inches and was at 247.11 feet, 2 inches below the upper monthly average limit. The Montreal Harbour level was 28.7 inches above average, but falling slowly. With Lake Ontario's level reaching a critical stage the Board's strategy was to release as much water as possible without causing levels near Montreal to reach flood stage. Increased discharges above those specified by Plan 1958-D would continue until after Lake Ontario's level had peaked. If the Ottawa River flows increased or if a rain event caused high levels in the Montreal area the Board would have reduced outflows as needed to prevent flooding.

Starting May 3<sup>rd</sup>, the Board carefully increased outflows above those specified by Plan 1958-D. Lake Ontario levels rose rapidly, peaking at 247.18 feet during May 3-10. Over-discharging continued until June 6<sup>th</sup>, when all of the temporarily stored water had been removed.

Judicious management by the Board of discretionary deviations from Plan 1958-D avoided appreciable adverse impact on stakeholders, or violation of the IJC's regulation criteria and the requirements of the Orders of Approval. Some of the Iroquois Dam gates were raised to their normal summer position on May 6<sup>th</sup>; however, accumulated debris delayed the complete raising of all gates until May 20<sup>th</sup>.

By June 6<sup>th</sup> Lake Ontario had fallen by 5 inches to 246.78 feet, 6.7 inches above average. It was decided to release outflows as prescribed by Plan 1958-D. From June 7<sup>th</sup> through December 12<sup>th</sup>, Plan-prescribed outflows were released as reiterated by the Board strategies decided at their May 14<sup>th</sup>, June 11<sup>th</sup> and August 13<sup>th</sup> teleconferences, as well as their September 17-18 and October 28<sup>th</sup> meetings. However, during the weekend of September 13-14, outflows were increased above those specified by the Plan to successfully assist a vessel entering the Port of Montreal. This temporary flow increase was offset by an equivalent decrease during the balance of the week such that there were no net deviations from the Plan flow for the week. As of December 12<sup>th</sup>, Lake Ontario's water level was 244.55 feet, 0.4 inches above its long term average and 9.8 inches above the level a year ago, with zero deviations.



**Figure 5: Lake Ontario Outflows**

Figure 5 above compares 2008 Lake Ontario outflows with period of record (1900-1999) monthly LTA outflows. Further information on ISLRBC activities can be found on the internet at: <http://www.islrbc.org>.

## **Public Concerns**

While water levels rose this year, the impacts of continued below average water levels on shipping, access, shoreline property, wetlands, businesses, erosion and water quality continue to be cause for concern. There is growing concern about the impacts of climate change and variability.

## **International Upper Great Lakes Study**

The purpose of the International Upper Great Lakes Study (IUGLS) is to investigate improvements to the regulation of the outflow of Lake Superior given the impacts regulation may have on water levels, flows, and consequently affected resources throughout the upper Great Lakes system. It also is closely examining the physical processes driving current Great Lakes water level conditions, and possible ongoing changes in the St. Clair River and their impacts on river flow and Lakes Michigan and Huron levels. These two issues are interrelated in that the outflow of Lakes Michigan-Huron, through the St. Clair River, plays a direct role in determining lake level, which in turn affects the regulated outflow from Lake Superior and the regulation objectives of the IJC Orders. The issues are being investigated by two Task Teams: the Lake Huron Outflow/ St. Clair River Task Team and the Lake Superior Regulation Task Team.

The Lake Huron Outflow/ St. Clair River Task Team is focusing on that part of the IUGLS which addresses the issues raised in the Plan of Study (POS) related to historic changes in the hydraulic conveyance capacity of the St. Clair River due to man-made changes (dredging, gravel mining, ship wrecks, hardening of the shoreline, conveyance constrictions due to bridges and other infrastructure, etc), natural physical changes associated with glacial isostatic rebound, overall reduction in net basin supplies due to climate change and variability effecting the Lake Huron outflow, or a combination of all of the aforementioned causes. Whatever the causes, the Task Team will also recommend a

range of technically feasible corrective remediation/mitigation actions, both structural and non-structural, if they are deemed warranted. The study of the St. Clair River and outflows of Lake Huron is expected to be completed by the middle of 2009 with a separate report to the IJC.

Throughout 2008, dozens of investigations have been underway. In addition to these investigations centered around hydraulic modeling of St. Clair River conveyance, defining the bathymetry and sediment character of the river and determining net basin supply components, the issue of uncertainty is being discussed related to the collected data and the results generated by the investigations. Extensive efforts to communicate with the public have been undertaken. Progress has also been made regarding the second phase of the Study on the development of options for improving the management of outflows from Lake Superior.

The following are highlights during 2008:

- The installation of four international side-looking acoustic Doppler current meters: one each on the Detroit, St. Clair and two units on the St. Marys River.
- Full river comparisons have been made of St. Clair River bathymetry for the 1971-2000 and 2000-2007 periods. However, the accuracy of available data especially for the earlier period was not great enough to reliably detect widespread geomorphic change throughout the St. Clair River at the scale required.
- One- and Two- Dimensional Model development is proceeding. Preliminary results appear to indicate an increase in conveyance over the 1971-2007 time periods but this appears to have stopped or reversed since 2000.
- Extensive mapping of the bed roughness and analysis of the fluvial nature of the St. Clair River in the vicinity of the Blue Water Bridge.

- The comparative analyses for determining net basin supply, over-lake precipitation, lake evaporation and basin runoff.
- An eddy covariance evaporation measurement device at Stannard Rock is operable and collecting over-lake data on Lake Superior – the first of its kind on the Great Lakes.
- Fifteen public meetings were held around the upper Great Lakes providing an opportunity to describe the Study and its preliminary findings to over 1500 participants. Also as part of the Study's outreach program, two newsletters were distributed.

#### **The International Lake Ontario-St. Lawrence River Study**

For almost 50 years, the IJC has regulated the flow of water from Lake Ontario to the St. Lawrence River through the Moses-Saunders Dam between Cornwall, Ontario and Massena, New York. The flows have been set under a 1956 Order of Approval issued by the IJC in accordance with the 1909 Boundary Waters Treaty between Canada and the United States.

In March 2008, following a five-year study and ensuing consultations, the IJC proposed a new Order and regulation plan that would address a broader range of interests, including the environment. The public was invited to express its views during a 105-day comment period that included information sessions and formal hearings across the Lake Ontario-St. Lawrence River basin. This exercise revealed serious divisions by political unit and interest with respect to regulating the flow of water from Lake Ontario to the St. Lawrence River and little support for the IJC's proposal.

Subsequently the IJC withdrew its proposal and is currently discussing with the two federal governments the possibility of establishing a working group to consider how best to move forward. The working group, whose members would include New York, Ontario, and Quebec,

in addition to the two federal governments and the IJC, would study the feasibility of developing a plan for the regulation of water levels and flows that would be based on a revised set of goals, objectives, and criteria. The working group's exploration of a new regulation plan will be linked to an adaptive management and monitoring program.

#### **Meetings with the Public**

The International Lake Superior Board of Control held its annual public meeting on June 12, 2008 at Sault College in Sault Ste. Marie, Ontario.

The International Niagara Board of Control met with the public on September 15, 2008 in Buffalo New York.

The International St. Lawrence River Board of Control held two meetings with the public. The first was held in Rochester New York on March 18, 2008. The second was held in Montreal, Quebec on September 17, 2008. Both meetings featured public teleconferences. More information on the activities of this Board can be found on their website: <http://www.islrbco.org/>

#### **Commercial Navigation**

The Soo Locks opened the 2008-2009 shipping season on March 25, 2008 as scheduled. Through November 2008, the estimated total tonnage passing through the Soo Locks at Sault Ste. Marie, MI was about 72.08 million short tons (MST) up 1.5% from the comparable 2007 tonnage of about 71.01 MST. U.S. and Canadian vessels carried 54.04 MST and 16.01 MST of cargo respectively, as compared to respective 2008 tonnages of 51.02 MST and 16.06 MST. Foreign flagged vessels carried about 2.03 MST, down from the 2007 tonnage of 3.93 MST.

An estimated total of 7,093 vessels had transited the locks as compared to 7,650 vessels the previous year. Cargo vessels totaled 3,892 compared to 4,083 in 2007. There were 2,378 U.S. flagged vessels, 1,271 Canadian flagged vessels and 243 foreign flagged vessels (ocean

going or “salties”). Other vessels transiting the locks such as pleasure craft, tour boats, Coast Guard and scientific research vessels numbered 3,201. The U.S. Locks will close on January 15, 2009 and reopen on March 25, 2009.

The Canadian lock at Sault Ste. Marie, Ontario opened on May 15, 2008. A serious malfunction of the lock gate closure system on October 1 resulted in an early end to the season. A total of 1,921 vessels carrying 61,940 passengers had transited the locks by that point in the season. The vessels were primarily tour boats and pleasure craft, as well as some commercial and government vessels. The lock is expected to reopen on May 15, 2008.

Preliminary figures through November 2008 indicate the tonnage passing through the Lake Ontario-Montreal section of the St. Lawrence Seaway was down about 9% from 2007 at about 26.8 million metric tons (MMT). Vessel traffic was down about 7.2% from 2007 at 2,457 (combined lake and ocean) vessels.

Preliminary data on the type of cargo transiting the Seaway through November 2008 include iron ore down 7.32% to about 8.53 MMT; iron and steel down 12.93% to about 1.53 MMT; grain down 30.34% to about 6.36 MMT; coal up 164.71% to 0.95 MMT; general cargo down 23.53% to about 1.77 MMT; and petroleum products up 19.30% to about 1.51 MMT. For additional details on Seaway activities visit their website at <http://www.greatlakes-seaway.com>. The St. Lawrence Seaway Development Corporation provided these figures.

### **New Lock**

A new “Poe-sized” lock is proposed to replace the existing Davis and Sabin Locks at the Soo Locks complex at Sault Ste. Marie, MI. The purpose of this project is to provide for more efficient movement of waterborne commerce. The Water Resources Development Act of 2007 directs that construction of the new lock shall be at full Federal expense. This authorization eliminates the need for the eight Great Lakes

States to cost share in the project. FY 2008 funds were used to obtain additional geotechnical data, issue an environmental bulletin as part of the NEPA process, prepare plans and specifications for the coffer dam (dewatering) contract, and continue detailed design of the lock chamber. In FY 2009 the plans and specs for the cofferdam contract will be completed, plans and specs for the guide wall/channel deepening contract will also be completed, and the detailed design report for the lock chamber will be completed. If sufficient funds are provided the cofferdam and the guide wall/channel deepening contracts could be awarded.

### **2008 Great Lakes Updates**

**2007 Annual Summary**, Vol. No. 170, January 2008.

**Guide to the Monthly Bulletin of Great Lakes Water Levels**, Vol. No. 171, April 2008.

**Origins of the Detroit District 1820 - 1865**, Vol. No. 172, July 2008.

**Frequently Asked Questions on Current Water Levels**, Vol. No. 173, October, 2008.

### **General Notes**

All elevations shown in this article are referenced to the IGLD 1985 datum. Information about the Great Lakes water levels, outflows, and weather is available at: <http://www.lre.usace.army.mil/glhh>